

REMARKS

Claims 1-7 and 15-19 are pending in the application. Claims 1-5, 7-17 and 19 were rejected. Claims 6 and 18 were objected to. Claims 8-14, drawn to a non-elected invention, have been withdrawn and are now cancelled, without prejudice to further prosecution in a divisional or continuation application.

Objections

The objections to the disclosure are noted and amendments have been made to address the issues raised based on the Examiner's suggestions. Withdrawal of the objections is respectfully requested.

Claim Rejections

Claims 1, 4, 5 and 7 were rejected under 35 U.S.C. §102(b) as being anticipated by US Patent No. 6,307,160 to Mei et al. ("Mei"). Claim 2 was rejected under 35 U.S.C. §103(a) as unpatentable over Mei. Claims 1-5 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over US Patent Application Publication No. 2002/0045036 A1 of Gorrell et al. ("Gorrell") in view of Mei. Claims 15-17 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Gorrell in view of Mei and further in view of US Patent No. 6,286,206 to Li ("Li").

The pending claims are directed to a flip chip package and an apparatus containing a flip chip package in which the package includes a flip chip bound to an electroless nickel immersion gold (ENIG) packaging substrate, and a doped solder ball array bonded to under bump metallization on the packaging substrate. The solder balls of the array are composed of a Pb/Sn bulk solder and a Cu, Al or Ni metal dopant in an amount of at least 0.2% by weight. The dopant in the Pb/Sn solder forms a compound or complex with the phosphorous residue from the electroless nickel plating process used in the substrate fabrication and prevents degradation of the solder/under bump metallization bond associated with phosphorus residue. The interfacial solder/under bump metallization bond is thereby strengthened. This results in fewer fractured solder bonds and greater package reliability.

Mei discloses the use of indium (In) in an amount of at least 2% by weight in Pb/Sn solder interconnects (balls) in ENIG, referred to in Mei as CENIGM, semiconductor flip chip packages. However, Mei's teaching is very specific to indium as the solder dopant. Mei provides no teaching of a solder additive other than indium and provides no guidance for the selection of any other solder additive to address the brittle interfacial fracture problem in ENIG packages. The Examiner's indication of a disclosure in Mei of Cu and Ni as metal dopants for

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Pb/Sn solder balls is noted, but Applicant's representative is unable to locate such disclosure. The disclosure in Mei of Cu and Ni as components of the CENIGM solder pad, for example at column 4, lines 27-36 and column 6, lines 8-14, just as the same is disclosed in the present application in the paragraph bridging pages 6 and 7, is noted. However, Mei consistently and exclusively discloses a solder ball composition of Pb, Sn and In (see, e.g., column 6, lines 14-19 and lines 35-40).

Accordingly, it is respectfully submitted that Mei does not provide a teaching of the use of Cu or Ni as solder ball dopants in an ENIG flip chip package, as claimed. Thus, withdrawal of the anticipation rejection under 35 U.S.C. §102(b) based on Mei is respectfully requested. In addition, since, as discussed above, Mei does not disclose or suggest Cu or Ni as solder ball dopants in an ENIG flip chip package, and this element of the claims is not provided by the other cited references, it is respectfully submitted that the combinations of references fail to establish *prima facie* cases of obviousness of any of the pending claims. Thus, withdrawal of the obviousness rejections under 35 U.S.C. §103(a) is also respectfully requested.

Allowable Subject Matter

Claims 6 and 18 were objected to as being dependent on a rejected base claim, but allowable if amended to incorporate the limitations of the base and any intervening claims. This indication of allowability is gratefully acknowledged. However, the claims have not yet been amended to independent form pending the Examiner's consideration of the arguments advanced above in favor of the patentability of all pending claims in their present form.

Conclusion

Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below. If any additional fees are due in connection with the filing of this amendment, the Commissioner is authorized to charge such fees to Deposit Account 500388 (Order No. ALTRP084C1).

Respectfully submitted,
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